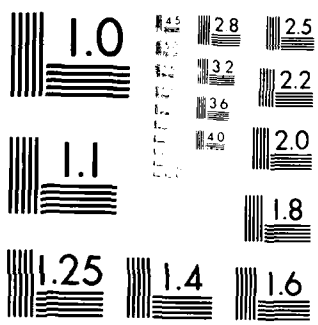
AD-A152 291 THE ORIGIN OF BRAIN POTENTIALS ASSOCIATED WITH SELECTIVE VISUAL ATTENTION(U) MEDICAL RESEARCH INST OF SAN FRANCISCO CA K NAKAYAMA ET AL. 30 NOV 84 1/1

UNCLASSIFIED AFOSR-TR-85-0246 AFOSR-83-0320 F/G 5/10 NL



SECURITY CLASS

AD-A152 291

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UMENTATION PAGE

1a. REPORT SEC	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY UNCLASSIFIED	3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution unlimited.
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S)	5. MONITORING ORGANIZATION REPORT NUMBER(S) AFOSR-TR- 85-0
6a. NAME OF PERFORMING ORGANIZATION Medical Research Institute Smith-Kettlewell Institute	6b. OFFICE SYMBOL (If applicable)
7a. NAME OF MONITORING ORGANIZATION Air Force Office of Scientific Research/NL	
6c. ADDRESS (City, State and ZIP Code) 2200 Webster Street San Francisco, Ca 94115	7b. ADDRESS (City, State and ZIP Code) Bldg 410 Bolling AFB.DC 20332
8a. NAME OF FUNDING/SPONSORING ORGANIZATION AFOSR	8b. OFFICE SYMBOL (If applicable) NL
9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER AFOSR -83-0320	
8c. ADDRESS (City, State and ZIP Code) Bldg. 410 Bolling AFB, DC 20332	10. SOURCE OF FUNDING NOS.

PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT NO.
61102F	2313	A5	

11. TITLE (Include Security Classification) The Origin of Brain Potentials Associated with Selective Visual Attention

12. PERSONAL AUTHOR(S) Nakayama, Ken; Mackeben, Manfred

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Yr., Mo., Day)	15. PAGE COUNT
Annual Scientific	FROM 09/01/83 TO 08/31/84	November 30,1984	Five

16. SUPPLEMENTARY NOTATION

17 COSATI CODES		
FIELD	GROUP	SUB. GR.

18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
Visual attention, Monkey
Evoked potential, P300
Human, Current source density analysis.

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

This study is designed to find the origins of electrical signals generated by the brain in association with selective visual attention. A series of behavioral and electrophysiological tests on humans as well as on trained, alert monkeys is proposed and progress in pursuit of the stated goal is reported.

20 DISTRIBUTION/AVAILABILITY OF ABSTRACT	21. ABSTRACT SECURITY CLASSIFICATION
UNCLASSIFIED/UNLIMITED ☑ SAME AS RPT. ☒ DTIC USERS ☐	UNCLASSIFIED

22a. NAME OF RESPONSIBLE INDIVIDUAL	22b. TELEPHONE NUMBER (Include Area Code)	22c. OFFICE SYMBOL
DR ALFRED R. FREGLY	202/767-5021	NL

DD FORM 1473, 83 APR EDITION OF 1 JAN 73 IS OBSOLETE.

DEC 11 1984

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE

AFOSR-TR- 83-0246

Annual Scientific Report
AFOSR-83-0320
30 November 1984

THE ORIGIN OF BRAIN POTENTIALS ASSOCIATED WITH SELECTIVE VISUAL ATTENTION

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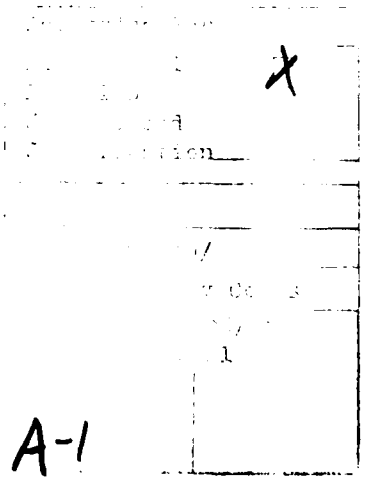

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Controlling Office: Air Force Office of Scientific Research/NL
Bolling AFB, DC 20332

THE ORIGIN OF BRAIN POTENTIALS ASSOCIATED WITH SELECTIVE VISUAL ATTENTION.

ABSTRACT: This study is designed to find the origins of electrical signals generated by the brain in association with selective visual attention. A series of behavioral and electrophysiological tests on humans as well as on trained, alert monkeys is proposed and progress in pursuit of the stated goal is reported.

KEYWORDS: Visual attention, evoked potentials, human, monkey, P300, current source density analysis.

Our long term goal is to elucidate the physiological mechanisms underlying selective visual attention. We have begun a study consisting of various steps in pursuit of this goal. In particular, we propose a series of behavioral experiments on humans and non-human primates, some of which will be associated with evoked potential recordings. This stage of the project is designed to help us find the most critical experimental conditions pertinent to our goal. It will demonstrate the existence of selective visual attention behaviorally and electrophysiologically, both, in regard to spatial as well as featural aspects of the stimuli. In addition, we will make simultaneous 16-channel recordings from different cortical areas of the alert monkey brain. The resulting data will be subjected to current source density analysis. Thus, we hope to determine the site of origin of electrical responses that are modulated by selective attention.

Our first year of this project was devoted mainly to technical aspects of the experiments:

1. We purchased and installed a new and more powerful computer (Digital Equipment Corp., LSI-11/23) for the laboratory in order to enhance the speed and efficiency of data acquisition and evaluation.

2. In order to save time by not having to write the necessary software ourselves, we customized an existing specialized software system. Specifically, we were able to obtain a software package especially written for electrophysiological applications from the Max-Planck-Institute for Psychiatry in Munich. F.R.G. In order to further expedite its implementation. the Co-PI and our computer programmer went to Munich in May 1984 to confer with the author. The majority of the necessary steps of customization for our experiments is now in place and functional. so that we could run a first series of successful experiments using the new system.

3. We completed the design, building, and testing of a needed anti-aliasing pre-filtering technique for 16 channels of analog data. In addition, this device can be supplemented by a digital filter routine (zero-delay, variable parameter Buterworth filter) installed in our software system.

Using the newly achieved capabilities of sophisticated experimental control and data acquisition, we have made a series of 16-channel surface recordings from human subjects. The evoked potentials in response to pattern pulses, pattern onset, and pattern offset at various spatial frequencies and contrast levels were investigated. In addition, we made recordings of evoked potentials in behaviorally more complex paradigms, particularly the "oddball" detection paradigm generally associated with the P300 brain wave. Here, the subject is instructed to correctly identify rare occurrences of certain stimulus configurations. The results show the well-known late positivity in electrodes placed over parietal areas and, as expected, a lack of response over occipital areas.

4. In order to improve our depth recording technique, especially by minimizing damage to the brain tissue, we acquired multi-channel electrodes that are much smaller than the ones used in our previous investigations. These electrodes have been developed by Dr. Otto Prohaska, of the University of Vienna and consist of a thin glass shaft with multiple gold contacts manufactured using thin-film deposition technology. To date, these are the only commercially available multi-channel recording electrodes manufactured by this technology. Dr. Prohaska is currently associated with the Department of Electrical Engineering at the University of Michigan and we anticipate a continuing collaboration with him. As a first step, Dr. Prohaska visited the Smith-Kettlewell Institute in the summer of 1984 to advise us during a first series of test recordings with his electrodes. It should be mentioned that hey have already proven their virtues in multi-channel recordings from mammalian cortical tissue conducted by other scientists (Rappelsberger et al., 1982).

Figure 1 is a photomicrograph of one of these electrodes taken under dark field illumination. It can be seen that the spacing between the contacts is extremely regular, in this case it is 100 microns. The size of each individual electrical contact is 25 x 25 microns.

In terms of the development of the behavorial training, we are continuing to use our monkey training system as described in Nakayama and Mackeben, 1982. In addition, however, we foresee a future need for a more flexible behavioral training system combined with a much more sophisticated type of visual display. To this end, we have borrowed a microcomputer system utilizing a very powerful video processing chip. We intend to program this computer in FORTH a very powerful operating system and language, which is well-suited to make on-the-spot changes in visual displays and reward contingencies when needed. Of principal importance is the availability of MOB's (Moveable Object Blocks) with this video display system. These can very easily be programmed to appear, to move, to change shape, color, and size, thus providing an ideal system to conduct the proposed experiments.

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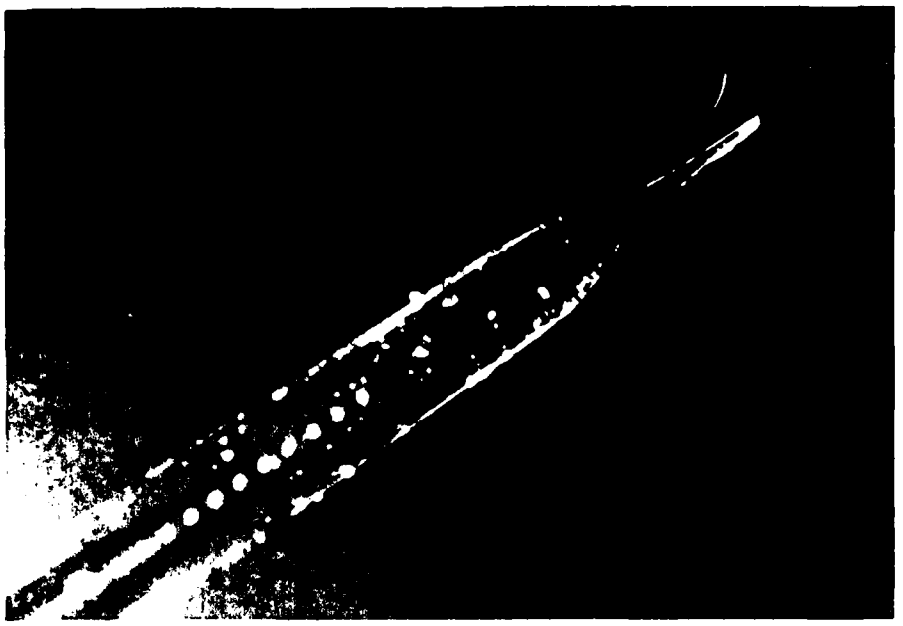

Figure 1

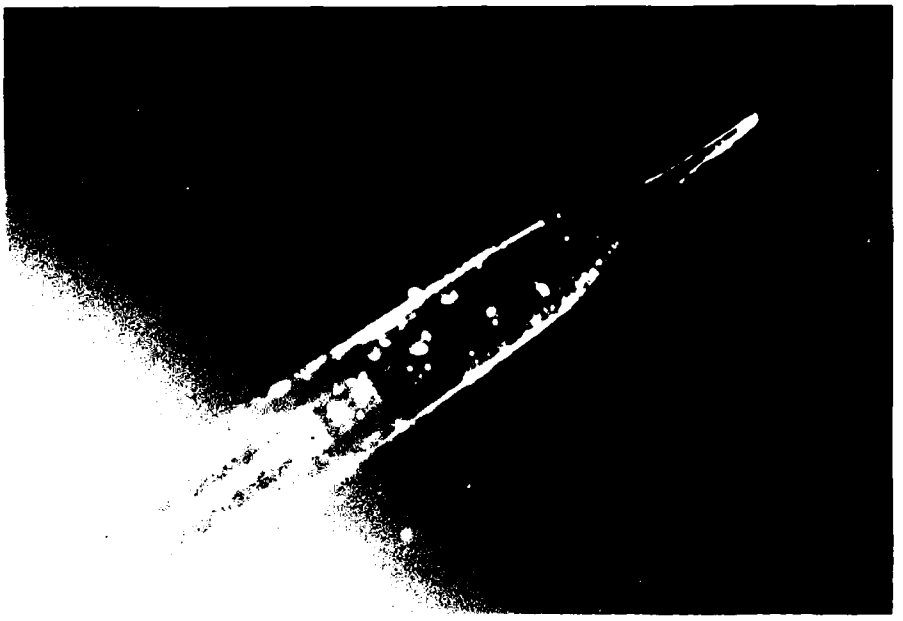

Figure 1

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